77 **PCT** (1) WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 4 :		(11) International Publication Number:
E21B 17/042, F16L 15/00	A1	WO 85/ 02651
		(43) International Publication Date: 20 June 1985 (20.06.85)

(21) International Application Number: PCT/US84/01988

(22) International Filing Date: 6 December 1984 (06.12.84)

(31) Priority Application Number: 562,448

(32) Priority Date: 16 December 1983 (16.12.83)

(33) Priority Country: US

(71) Applicant: HYDRIL COMPANY [US/US]; 714 West Olympic Boulevard, Los Angeles, CA 90015 (US).

(72) Inventor: FURGERSON, David, J. ; 1413 N.E. 103rd., Kirkland, WA 98033 (US).

(74) Agent: CHRYSTAL, John, J.; Ladas & Parry, 104 S. Michigan Avenue, Chicago, IL 60603 (US).

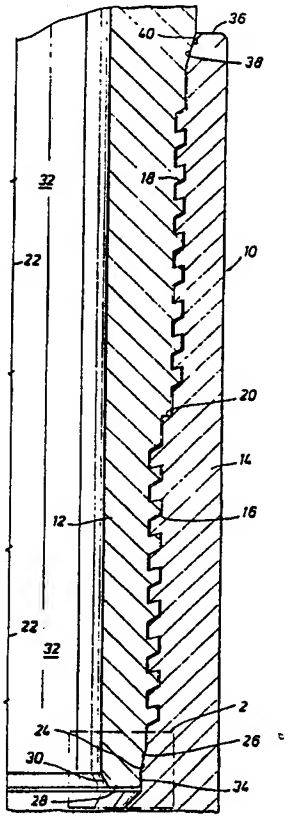
(81) Designated States: AT (European patent), BE (European patent), BR, CH (European patent), DE (European patent), DK, FR (European patent), GB, GB (European patent), JP, LU (European patent), NL (European patent), NO, SE (European patent).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: TUBULAR CONNECTION

(57) Abstract

An improved pin member (12) adapted for use in a tubular connection where said pin member is adapted for coaxial threaded engagement with a box member (14) having a counterbore for receiving the pin member (12). A pilot surface (34) is disposed from a distal-proximate end to the distal end of the pin member (12) inclining to a lesser extent than the angle of the incline of an internal sealing surface (24) of the pin member. The pilot surface (34) is substantially parallel to the axis of the connection (22). This poilot surface allows the end-of-pin flat (28) thickness to be increased thereby allowing positioning of the interengaged threads (16, 18) so as to provide an increased annulus thickness of the box member (14) thereby increasing the axial tensile strength capability and burst pressure rating of said tubular connection while additionally protecting said internal surface of said pin member (12) and providing a rugged end-of-pin flat (28). Additionally, a pilot surface (34) is presented for the free end of a box member so as to provide additional protection of the external sealing surface of the box member and providing a more rugged end-of-box flat (36).



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**GA**	Gabon	**MR**	Mauritania
AU	Australia	**GB**	United Kingdom	**MW**	Malawi
BB	Barbados	**HU**	Hungary	**NL**	Netherlands
BE	Belgium	**IT**	Italy	**NO**	Norway
BG	Bulgaria	**JP**	Japan	**RO**	Romania
BR	Brazil	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SN**	Senegal
CH	Switzerland	**LI**	Liechtenstein	**SU**	Soviet Union
CM	Cameroon	**LK**	Sri Lanka	**TD**	Chad
DE	Germany, Federal Republic of	**LU**	Luxembourg	**TG**	Togo
DK	Denmark	**MC**	Monaco	**US**	United States of America
FI	Finland	**MG**	Madagascar		
FR	France	**ML**	Mali		

TUBULAR CONNECTION

This invention relates generally to the field of threaded connectors and in particular to threaded connectors for tubular goods having pin and box members.

The need for a threaded connector for tubular goods having an axial tensile capability substantially equal to that of the tubular goods has long been recognized. Additionally, increased burst pressure rating for the tubular goods has long been considered beneficial. By tubular goods it is to be understood that drill pipe, work tubing, production tubing, well casing and other such conduits used in a well are included. It is also to be understood that the use of the threaded connector of the present invention is not to be considered limited to such tubular goods.

In the design of tubular connections, critical boundary conditions must be considered, one of these boundary conditions being the requirement for a minimum thickness at the distal end or end-of-pin flat of the pin member in order to maintain ruggedness under manufacturing, transporation and field running and handling conditions. A geometry change at the end of the pin member that would increase the end-of-pin flat thickness would allow optimization of other critical performance features for boundary conditions.

Current end-of-pin geometry restricts design optimization procedures and therefore restricts

maximization of connection performance. Some commercially available tubular connections with current end-of-pin geometry are sold under the mark "Triple Seal" by the Hydril Company. Such "Triple Seal" connections have featured three positive metal-to-metal seals comprising a fourteen (14) degree external seal, a middle ninety (90) degree torque shoulder and seal and a fourteen (14) degree pin to box internal seal. The connections have been offered as two-step cylindrical threaded surfaces with modified buttress threads. A new generation of thread design sold under the marks, "Triple Seal II" or "MAC", also use the current end-of-pin geometry. The "Triple Seal II" or "MAC" designs also feature three positive metal-to-metal seals comprising fourteen (14) external seals, a middle shoudler and a fourteen (14) degree pin to box internal seal.

The end-of-pin geometry of the above mentioned designs requires that increased tensile strength and burst pressure rating be achieved by decreasing the pin annulus thickness which therefore would allow an increase in the box annulus thickness, but this would in turn present undesirable excessively thin end-of-pin flats. Also the current end-of-pin geometry does not offer optimal protection of internal and external sealing surfaces. Furthermore, the end-of-pin geometry of current designs is difficult to field repair without damaging the sealing surfaces.

The present invention aims to provide an apparatus for an improved tubular connection which is not subject to the disadvantages discussed above and which provides improved connection performance without violation of the end-of-pin boundary condition which requires a minimum thickness at the end of the pin in order to maintain ruggedness under field running and handling conditions.

The present invention therefore provides a tubular connection of pin and box members defining an axis comprising, interengaged threads on the respective members, cooperating internal frusto-conical surfaces respectively on a counterbore of the box member and a free end of the pin member, the box member having an annular outwardly facing internal surface inclining at an angle with respect to the axis of the tubular connection, the pin member having an annular inwardly facing internal surface adjacent the end of the pin member, the angle of incline of the pin internal surface being substantially the same as that of the box internal surface, a pilot surface disposed from a distal-proximate end to the distal end of the pin member inclining to a lesser extent than the angle of incline of the internal surface of the pin member thereby defining an end-of-pin flat, whereby said pilot surface and, therefore, said increased end-of-pin flat thickness allows positioning of said interengaged threads so as to provide an increased annulus thickness of said box member thereby increasing the tensile strength and burst pressure rating of said connection while additionally protecting said internal surface of said pin member.

Further, the invention is also directed to an improved pin member adapted for use in a tubular connection, said pin member adapted for coaxial threaded engagement with a box member having a counterbore for receiving the pin member wherein said pin member has an internal surface inclining inwardly with respect to the axis of the tubular connection adjacent the end of the pin member and the angle of incline of a cooperating internal surface of the box member is substantially the same as that of the internal surface of the pin member, wherein the improvement comprises, a pilot surface disposed from a distal-proximate end to

the distal end of the pin member inclining to a lesser extent from the angle of incline of the internal surface of the pin member, whereby said pilot surface allows positioning of said threads so as to provide an increased annulus thickness of said box member thereby increasing the axial tensile strength capability and burst pressure rating of said tubular connection while additionally protecting said internal surface of said pin member and providing a rugged end-of-pin flat.

In addition, the invention is related to an improved box member adapted for use in a tubular connection, said box member adapted for coaxial threaded engagement with a pin member, said members having cooperating external frusto-conical surfaces, the box member having disposed on the free end of a counterbore an annular outwardly facing external surface inclining at an angle with respect to the axis of the tubular connection, the pin member having an external surface inclining inwardly, the angle of incline of the box external surface being substantially the same as that of the pin external surface, wherein said improvement comprises, an external pilot surface disposed from a distal-proximate end to the distal end of the box member inclining to a lesser extent than the angle of incline of the external surface of the box member, whereby said external pilot surface protects said external surface of said box member and provides a rugged end-of-box flat.

The new geometry of the pilot surface or bull nose and therefore the increased end-of-pin thickness allows the boundary condition for a minimum thickness at the end-of-pin to be met while allowing the pin annulus thickness to be decreased, thereby increasing the box annulus thickness. The increased box annulus thickness increases the axial tensile strength capability and burst pressure rating of the connection. The bull nose also protects the internal

sealing surface of the pin member in handling. Also, the new geometry allows easier repairs of a damaged end-of-pin flat under field running and handling.

Further advantages and features of the invention will become more apparent by reference to the drawings which are appended hereto and wherein like numerals indicate like parts and wherein preferred embodiment of the invention is shown, of which:

Figure 1 is a cross-section illustration of a tubular connection according to the invention, showing the bull nose or pilot surface at the end of the pin member;

Figure 2 is an illustration of the cooperating internal sealing surfaces and bull nose or pilot surface and further illustrates the novel geometry of the end-of-pin which provides an increased end-of-pin flat thickness; and

Figure 3 is an alternative embodiment of the invention as shown in Figure 1 in which the box member is provided with a bull nose or external pilot surface, further illustrated is the increased end-of-box flat thickness.

The tubular connection 10 embodying the improvements of the present invention is shown in detail in Figures 1 through 3.

Referring to Figure 1, the tubular connection or pipe joint 10 of a pin member 12 and box member 14 is illustrated. First and second pairs of interengaged threads 16 and 18 are provided, respectively. A pair of cooperating intermediate shoulders/sealing surfaces 20 are axially disposed between the first and second pairs of interengaged threads. The pin member 12 is adapted for coaxial threaded engagement with the box member 14 whereby the axis 22 of the tubular connection is defined.

According to the invention, as illustrated in

Figures 1 and 2, cooperating frusto-conical annular internal sealing surfaces comprise an inwardly facing internal sealing surface 24 disposed on a free end of the pin member 12 and an outwardly facing internal sealing surface 26 disposed on a counterbore of the box member 14. The pin member 12 has its end-of-pin flat 28 which is defined by the interior surface 30 of bore 32 of the tubular connection 10 and the pilot surface or bull nose 34 of the pin member 12.

According to the invention, referring to Figure 1, box member 14 is illustrated with an end-of-box flat 36, as is well known in the prior art design of sealing surfaces and end-of-box flats. The sealing surface 38 is at an angle of incline of fourteen (14) degrees which continues to the end-of-box flat. Co-operating external frusto-conical sealing surface 40 of the pin member 12 is shown in sealing engagement with sealing surface 38 of box member 14. Note that nc bull nose is shown on the external sealing surface of the box member in Figure 1. Preferably, the internal sealing surfaces are annular frusto-conical sealing surfaces provided at substantially the same angle with respect to the axis of the connection. Typically, this angle is fourteen (14) degrees. Likewise, the cooperating external sealing surfaces 38 and 40 on the box and pin member, respectively, are also annular frusto-conical sealing surfaces provided at an angle of approximately fourteen (14) degrees.

Turning now to Figure 2, a detailed view of the internal sealing surfaces 24 and 26 are illustrated along with the present invention of a pilot surface or bull nose 34. The pilot surface 34 is shown in the preferred embodiment as substantially parallel to the axis 22 of the tubular connection 10. This angle of incline of the pilot surface, therefore, is of a lesser extent than the fourteen (14) degree angle of incline of the internal sealing surface 24 of the pin member 12.

This pilot surface provides an increased end-of-pin thickness Δ_1 to the end-of-pin flat 28 over the prior art geometry design where the surface would have been defined by an angle equal to or greater than the angle of the internal sealing surface 24 as illustrated by the dashed line 47. The internal sealing surface 24 is provided with a back relief surface 42 of an angle less than the angle of the sealing surface with respect to the axis 22 of the tubular connection 10. Usually this angle is nine (9) or ten (10) degrees from the axis of the tubular connection. The back relief surface 42 provides a gap 44 between the box member 14 and pin member 12. The cooperating surface 46 of the box member is preferably not an interference fit with the pilot surface 34. A gap 4 is provided between the pilot surface 34 and cooperating surface 46.

Further in accordance with the invention, an alternative view, Figure 3, illustrates a bull nose or external pilot surface 50a located on the free end of the box member 14. This external pilot surface 50a is substantially juxtaposed to the external sealing surface 38a of the box member 14a. The external pilot surface is disposed from distal-proximate end to the distal end of the box member 14a. The external sealing surface 38a of the box member 14a cooperates with the external sealing surface 40a of the pin member 12a. The increased end-of-box flat 36a thickness from that shown in Figure 1 or the dashed line 57a is indicated by Δ_2. A gap 52a is illustrated in Figure 3 where the relief 54a on box member 14a is illustrated. The angle of the back relief 54a is usually between nine (9) degrees to ten (10) degrees from the axis of the connection. The external pilot surface 50a is preferably a non-interference fit with the cooperating pin surface 56a so as to provide a gap 58a therebetween.

In the use and operation of this invention, the bull nose can be provided on the pin member or box member free end so as to provide an increased end-of-pin or end-of-box flat thickness so as to provide additional resistance to damage of the respective members sealing surfaces as well as their flats. Also, the new geometry of the pilot surfaces aids in the repair of damage over the current end-of pin and end-of-box geometry.

More importantly, pursaunt to the invention, the pilot surface or bull nose of the pin member produces increased end-of-pin thickness thereby allowing the annulus thickness of the pin member 12 to be reduced and still maintain the boundary condition of minimum thickness at the end of the pin in order to maintain ruggedness under field running and handling conditions. This reduction of the thickness of the pin member 12 annulus allows the box member 14 annulus thickness to be increased while maintaining the same overall thickness of the tubular connection. The increased box annulus increases the axial tensile strength capability and burst pressure rating of the tubular connection.

CLAIMS

1. A tubular connection of pin and box members defining an axis comprising, interengaged threads on the respective members, cooperating internal frusto-conical surfaces respectively on a counterbore of the box member and a free end of the pin member, the box member having an annular outwardly facing internal surface inclining at an angle with respect to the axis of the tubular connection, the pin member having an annular inwardly facing internal surface adjacent the end of the pin member, the angle of incline of the pin internal surface being substantially the same as that of the box internal surface, characterized in that said connection includes a pilot surface disposed from a distal-proximate end to the distal end of the pin member inclining to a lesser extent than the angle of incline of the internal surface of the pin member thereby defining an end-of-pin flat, whereby said pilot surface and, therefore, said increased end-of-pin flat thickness allows positioning of said interengaged threads so as to provide an increased annulus thickness of said box member thereby increasing the tensile strength and burst pressure rating of said connection while additionally protecting said internal surface of said pin member.

2. The tubular connection of claim 1, characterized in that said cooperating internal frusto-conical surfaces are sealing surfaces.

3. The tubular connection of claim 2, characterized in that the sealing surfaces are of the crown-type.

4. The tubular connection of claim 2 or 3, characterized in that the angle of incline of the internal sealing surfaces is substantially 14^{o} from the axis of the connection.

5. The tubular connection of claim 1, 2 or 3, characterized in that said pilot surface is substantially

juxtaposed to said internal surface of said pin member.

6. The tubular connection of claim 1, 2 or 3, characterized in that said pilot surface is substantially parallel to the axis of the tubular connection.

7. The tubular connection of claim 1, characterized in that said threads comprise first and second pairs of interengaged threads on the respective members, the first pair of threads being axially spaced from the second pair of threads and the first pair of threads being radially stepped with respect to the second pair of threads.

8. The tubular connection of claim 7, characterized by a pair of shoulders on the pin and box members disposed axially between the first and second pairs of threads.

9. An improved tubular connection having a pin member and a box member defining an axis, said connection having interengaged threads on the respective members and said pin member having an internal frusto-conical surface inclining inwardly towards said axis adjacent the end of the pin member and said box member having a cooperating internal frusto-conical surface with an angle of incline substantially the same as that of the internal surface of the pin member, characterized in that said connection includes a pilot surface disposed from a distal-proximate end to the distal end of the pin member inclining to a lesser extent than the angle of the incline of the internal surface of the pin member thereby defining an increased end-of-pin flat thickness relative to an end-of-pin flat thickness defined by a surface inclined equal to or to a greater extent than the angle of incline of said pin internal surface, whereby said pilot surface and, therefore, said increased end-of-pin flat thickness allows positioning of said interengaged threads so as to provide an increased annulus thickness of said

box member thereby increasing the axial tensile strength capability and burst pressure rating of said connection while also protecting said internal surface of the pin member.

10. The tubular connection of claim 9, wherein said cooperating internal frusto-concical surfaces are sealing surfaces.

11. The tubular connection of claim 10, characterized in that the sealing surfaces are of the crown-type.

12. The tubular connection of claim 10 or 11, characterized in that the angle of incline of the internal sealing surfaces is substantially 14° from the axis of the connection.

13. The tubular connection of claim 9, 10, or 11, characterized in that said pilot surface is juxtaposed to said internal surface of said pin member.

14. The tubular connection of claim 9, 10 or 11, characterized in that said pilot surface is substantially parallel to the axis of the tubular connection.

15. The tubular connection of claim 9, 10 or 11, characterized in that said box member has a complementary non-interference surface cooperating with said pilot surface of said pin member.

16. The tubular connection of claim 9, characterized in that said threads comprise first and second pairs of interengaged threads on the respective members, the first pair of threads being axially spaced from the second pair of threads and the first pair of threads being radially stepped with respect to the second pair of threads

17. The tubular connection of claim 16, characterized by a pair of shoulders on the pinand box members disposed axially between the first and second pairs of threads.

18. The tubular connection of claim 9 char-

acterized by an external pilot surface for the box member, wherein said pin and box members have cooperating external frusto-conical surfaces, the box member having an annular outwardly facing external surface disposed on the free end of the counterbore inclining at an angle with respect to the axis of the tubular connection, the pin member having an external surface inclining inwardly from the axis of the tubular connection wherein the angle of incline of the pin external surface is substantially the same as that of the box external surface, the external pilot surface disposed from a distal-proximate end to the distal end of the free end of the box member wherein the angle inclines to a lesser extent that the angle of incline of the external surface of the box member, whereby said external pilot surface provides additional protection of said external surface of said box member and provides a rugged end-of-box flat.

19. The tubular connection of claim 18, characterized in that said external frusto-conical surfaces are sealing surfaces.

20. A pin member adapted for coaxial threaded engagement with a box member in a tubular connection, said box member having a counterbore for receiving the pin member, said pin member comprising, an internal frusto-conical surface inclining inwardly with respect to the axis of the tubular connection adjacent the end of the pin member; the angle of incline of a cooperating internal frusto-conical surface of the box member being substantially the same as that of the internal surface of the pin member, characterized in that said pin member includes a pilot surface disposed from a distal-proximate end to the distal end of the pin member inclining to a lesser extent than the angle of incline of the internal surface of the pin member, whereby said pilot surface allows positioning of said

threaded engagement so as to provide an increased annulus thickness of said box member thereby increasing the axial tensile strength capability and burst pressure rating of said connection while additionally protecting said internal surface of the pin member.

21. The pin member of claim 20, characterized in that said cooperating internal frusto-conical surfaces are sealing surfaces.

22. The pin member of claim 21, characterized in that the sealing surfaces are of the crown-type.

23. The pin member of claim 21 or 22, characterized in that the angle of incline of the internal sealing surface of the pin member is approximately 14^{o} from the axis of the connection.

24. The pin member of claim 20, 21 or 22, characterized in that said pilot surface is substantially juxtaposed to said internal surface of said pin member.

25. The pin member of claim 20, 21 or 22, characterized in that said pilot surface is substantially parallel to the axis of the tubular connection.

26. The pin member of claim 20, characterized in that said threaded engagement comprises first and second pairs of interengaged threads on the respective members, the first pair of threads being axially spaced form the second pair of threads and the first pair of threads being radially stepped with respect to the second pair of threads.

27. The pin member of claim 26, characterized by a pair of shoulders on the pin and box members disposed axially between the first and second pairs of threads.

28. An improved pin member adapted for use in a tubular connection, said pin member adapted for coaxial threaded engagement with a box member having a

counterbore for receiving the pin member wherein said pin member has an internal surface inclining inwardly with respect to the axis of the tubular connection adjacent the end of the pin member and the angle of incline of a cooperating internal surface of the box member is substantially the same as that of the internal surface of the pin member, characterized in that said pin member includes a pilot surface disposed from a distal-proximate end to the distal end of the pinmember inclining to a lesser extent from the angle of incline of the internal surface of the pin member, whereby said pilot surface allows positioning of said threads so as to provide an increased annulus thickness of said box member thereby increasing the axial tensile strength capability and burst pressure rating of said tubular connection while additionally protecting said internal surface of said pin member and providing a rugged end-of-pin flat.

29. The pin member of claim 28, characterized in that said cooperating internal frustoconical surfaces are sealing surfaces.

30. The pin member of claim 29, characterized in that the sealing surfaces are of the crown-type.

31. The pin member of claim 29 or 30, characterized in that the angle of incline of the internal sealing surface of the pin member is substantially 14^{o} from the axis of the connection.

32. The pin member of claim 28, 29 or 30, characterized in that said pilot surface is substantially juxtaposed to said internal surface of said pin member.

33. The pin member of claim 28, 29 or 30, characterized in that said pilot surface is substantially parallel to the axis of the tubular connection.

34. An improved box member adapted for use in a tubular connection, said box member adapted for

coaxial threaded engagement with a pin member, said members having cooperating external frusto-conical surfaces, the box member having disposed on the free end of a counterbore an annular outwardly facing external surface inclining at an angle with respect to the axis of the tubular connection, the pin member having an external surface inclining inwardly, the angle of incline of the box external surface being substantially the same as that of the pin external surface, characterized in that said box member includes an external pilot surface disposed from a distal-proximate end to the distal end of the box member inclining to a lesser extent than the angle of incline of the external surface of the box member, whereby said external pilot surface protects said external surface of said box member and provides a rugged end-of-box flat.

35. The box member of claim 34, characterized in that said cooperating external frusto-conical surfaces are sealing surfaces.

36. The box member of claim 35, characterized in that the sealing surfaces are of the crown-type.

37. The box member of claim 34, 35 or 36, characterized in that said pilot surface is juxtaposed to said internal surface of said pin member.

38. The box member of claim 34, 35, or 36, characterized in that said pilot surface is substantially parallel to the axis of the tubular connection.

39. The box member of claim 34, characterized in that said threaded engagement comprises first and second pairs of interengaged threads on the respective members, the first pair of threads being axially spaced from the second pair of threads and the first pair of threads being radially stepped with respect to the second pair of threads.

40. The box member of claim 39, character

ized by a pair of shoulders on the pin and box members disposed axially between the first and second pairs of threads.

FIG. 1

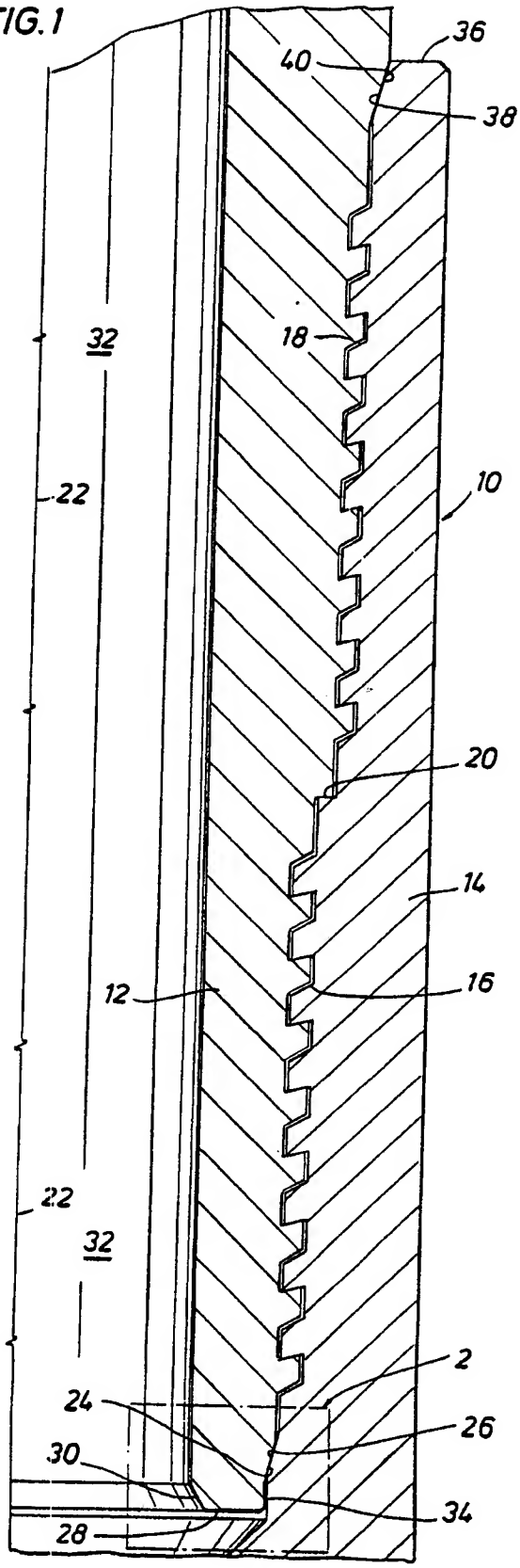


FIG. 2

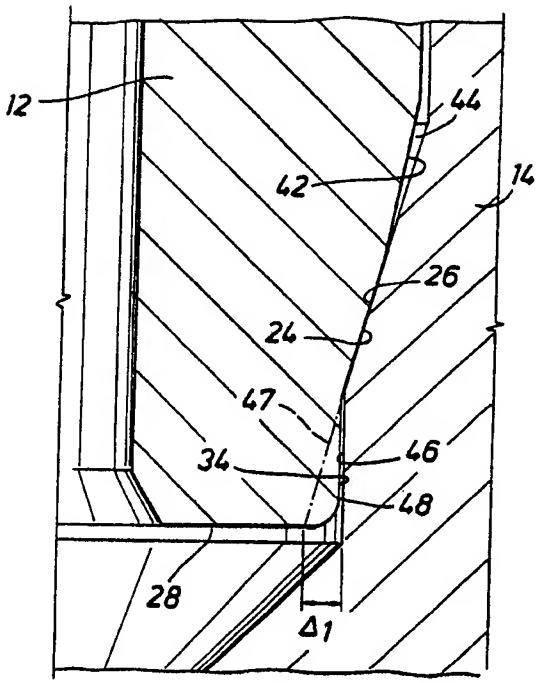
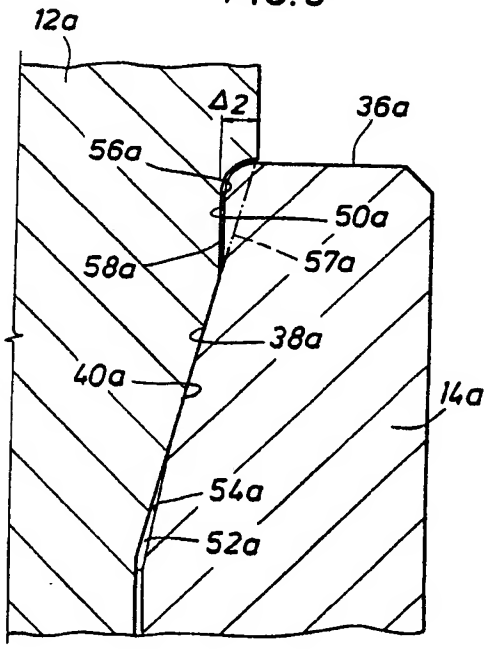


FIG. 3



INTERNATIONAL SEARCH REPORT

International Application No PCT/US 84/01988

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: E 21 B 17/042; F 16 L 15/00

II. FIELDS SEARCHED

Minimum Documentation Searched

Classification System	Classification Symbols
IPC[4]	E 21 B; F 16 L

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched

III. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	US, A, 2211179 (STONE) 13 August 1940 see the entire document	1-4,7-12,16-23,26-31,34-36,39,40
A	US, A, 2450452 (SCOTT) 5 October 1948 see figures and claims	1,2,4,9,12,18-20,28,34,35
A	US, A, 4373754 (BOLLFRASS et al.) 15 February 1983 see figures and claims	1-13,16-18,20-23,26-31,34-36,39,40
A	DE, C, 812905 (HUGHES TOOL COMPANY) 8 July 1949 see the entire document	1,9,18,20,28 34
A	US, A, 2308066 (EVANS) 12 January 1943	./.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
21st March 1985	17 AVR. 1985
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	G.L.M. Kruydenberg

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
	see figure 1; claims	1,9,18,20, 28,34
	--	
A	DE, C, 827935 (HUGHES TOOL COMPANY) 14 January 1952 see figures	1,9,18,20, 28,34
	--	
A	GB, A, 678613 (DEHN) 3 September 1952 see page 4, lines 17-119; figures	1,9,18,20, 28,34
	--	
A	GB, A, 508664 (HYDRIL) 4 July 1939 see figures 5-8	1,9,18,20, 28,34
	--	
A	FR, A, 1223674 (AMERICAN IRON & MACHINE) 20 June 1960 see figure	1
	--	
A	US, A, 2160263 (FLETCHER) 30 May 1939 see figure	1

INTERNATIONAL APPLICATION NO. PCT/US 8401988 (SA 8450)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 11/04/85

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 2211179		None	
US-A- 2450452		None	
US-A- 4373754	15/02/83	None	
DE-C- 812905		None	
US-A- 2308066		None	
DE-C- 827935		None	
GB-A- 678613		None	
GB-A- 508664		None	
FR-A- 1223674		None	
US-A- 2160263		None	